

Text table 7-4.
Environmental worries

Issue	Worry “a great deal” (percent)			
	1997	1999	2000	2001
Pollution of drinking water	NA	68	72	64
Pollution of rivers, lakes, and reservoirs	NA	61	66	58
Contamination of soil and water by toxic waste	NA	63	64	58
Contamination of soil and water by	NA	48	52	49
radioactivity from nuclear facilities				
Air pollution	42	52	59	48
Loss of natural habitat for wildlife	NA	51	51	48
Damage to Earth’s ozone layer	33	44	49	47
Loss of tropical rain forests	NA	49	51	44
Ocean and beach pollution	NA	50	54	43
Extinction of plant and animal species	NA	NA	45	43
Urban sprawl and loss of open space	NA	NA	42	35
“Greenhouse effect” or global warming	24	34	40	33
Acid rain	NA	29	34	28

NA = not available

SOURCE: Gallup Organization, “Only One in Four Americans Are Anxious About the Environment,” Poll Release (Princeton, NJ, 2001).

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to vote for a presidential candidate in the November 2000 election if the candidate supported Federal efforts to strengthen U.S. science and math education (Bayer/NSF 2000).

Two NSF/Bayer surveys conducted in 2000 and 2001 included questions about public attitudes toward the results of the Third International Math and Science Study (TIMSS). One of the key findings of TIMSS, first conducted in 1995 and repeated in 1999 (see chapter 1, “Elementary and Secondary Education”), was that high school seniors in the United States performed poorly in tests of their knowledge of science and math. In fact, they ranked last or nearly last among the students who participated in TIMSS.

According to the 2000 NSF/Bayer survey, most people were unaware of the TIMSS results, although they received a considerable amount of coverage in the press. Only 7 percent of those queried knew that the scores of U.S. seniors were considerably lower than those of students in most other participating countries; nearly 50 percent thought that U.S. students scored average or higher. However, after being informed of the TIMSS results, almost everyone expressed concern, and 52 percent said that they were very concerned.

In 2001, two-thirds of NSF/Bayer survey respondents considered the TIMSS-R results a warning sign that “U.S. students may be inadequately prepared for the workplace when they enter it in several years.”

Public Image of the Science Community

It is generally conceded that scientists and engineers have somewhat of an image problem (Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development 2000). Although

their intelligence and work are highly respected (see “Public Confidence in Leadership of the Science Community”), that admiration does not seem to extend to other aspects of their lives. The charming and charismatic scientist is not an image that populates popular culture.³⁴ For example, the entertainment industry often portrays certain professions such as medicine, law, and journalism as exciting and glamorous, whereas scientists and engineers are almost always portrayed as unattractive, reclusive, socially inept white men or foreigners working in dull, unglamorous careers. (See sidebar “Few Scientists in Prime Time.”)

Why does public image matter? What difference does it make if the public image of scientists and engineers is less than positive? Public image is important for at least two reasons:

- ♦ Scientists represent the first line of communication about science to the general public. That is, they are responsible for conveying information, often through the news media, about scientific issues. They can also help the public understand the importance of science and appreciate its benefits. Image has a lot to do with how effective that communication is in capturing the attention of the public. The more appealing the image, the more likely that people will listen to what is being said.

³⁴See Goldman (1989). Theater also helps reinforce the stereotype. In the recent, Pulitzer prize and Tony-winning play *Proof*, mathematicians are portrayed as “a bunch of brilliant but crazy nerds who do things that are impossible to understand” (Davis 2001). Others, however, like author, screenwriter, and physician Michael Crichton defend Hollywood’s depiction of science and technology. Movies such as *Jurassic Park* provide a needed balance to the “round-the-clock boosterism” science and technology usually receive in our society. According to Crichton (American Association for the Advancement of Science annual meeting in Anaheim California 1999), scientists are not the only professionals negatively portrayed on the big screen. Accountants, police officers, and politicians also frequently receive less than positive treatment.

Few Scientists in Prime Time

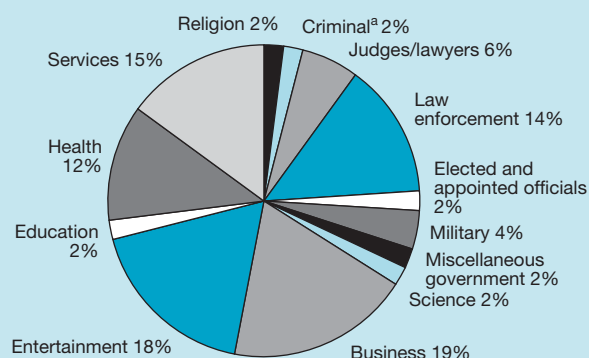
Few characters on prime time television shows are scientists. According to a recent study, the percentage of scientists was typically less than 2 percent in the mid-1990s (Gerbner and Linson 1999). Figure 7-13 provides the breakdown for the professions of all characters in prime time between 1994 and 1997. In 1994, 2.3 percent of the characters on nighttime TV shows were scientists. Comparable figures for 1995, 1996, 1997, and 1998 were 1.6, 1.9, 1.8, and 1.0 percent, respectively.*

If scientists seldom show up on the small screen, the appearance of women and minorities as scientists is even more

rare. During the period of the study, white men constituted 41 percent of the U.S. population, played 53 percent of all TV roles, and played 75 percent of the scientists. The corresponding statistics for white women were 42, 31, and 13 percent, respectively. Minorities were similarly underrepresented in the science profession on TV. However, the reverse was true for foreign nationals—only 3 percent of all characters on prime time shows were foreign nationals, but 9 percent of the scientists were members of this group. (See text table 7-5.)

*It should be noted that the 2 percent statistic for scientists in prime time probably does not differ that much from their total representation in the U.S. workforce. However, this issue can be looked at from the opposite perspective, that is, that members of other professions (e.g., doctors and lawyers) are probably overrepresented in prime time, which is not the case with respect to scientists.

Figure 7-13.
Occupations of characters in prime time dramatic entertainment: 1994–1997



^aAlthough 4% (N = 245) of all characters committed crime during sample period, only 2% were identified with "criminal" as their main occupation.

NOTE: Occupations of 3,577 characters whose occupations are identified, from total sample of 6,882 speaking characters appearing in weekly samples of prime time dramatic entertainment programs (1994–97).

SOURCE: G. Gerbner and B. Linson, "Images of Scientists in Prime Time Television: A Report for the U.S. Department of Commerce From the Cultural Indicators Research Project" (Washington, DC: U.S. Department of Commerce, 1998). Unpublished report.

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Text table 7-5.
Who plays scientists on television: 1994–97
(Percentages)

Characteristics	U.S. population	Television characters	
		Prime time characters	Scientists in prime time
White			
Male	41.0	52.7	75.0
Female	42.1	30.7	13.2
Black			
Male	6.0	7.3	8.3
Female	6.6	4.9	1.4
Hispanic ^a	11.0	2.5	0.0
Asian	3.0	1.6	0.7
Foreign national origin ...	10.0	3.2	9.0
Disabled	19.0	0.7	0.7

^aHispanics may be of any race and are included in totals for each racial group as appropriate.

SOURCE: G. Gerbner and B. Linson, "Images of Scientists in Prime Time Television: A Report for the U.S. Department of Commerce From the Cultural Indicators Research Project" (Washington, DC, U.S. Department of Commerce, 1998), unpublished report.

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- ♦ Children are strongly influenced by the images they see around them at home, at school, and in popular culture. Researchers in this field point out that television has a tremendous influence on children's attitudes and behaviors, and what they see on television can affect the choices they make in life, including the careers they choose.³⁵ If they harbor negative stereotypes of scientists and engineers as nerdy and weird-looking, then they could reject science and engineering as potential careers.³⁶

³⁵According to one study of 1,500 television viewers, the more that people watch television, the more they think scientists are odd and peculiar (Gerbner and Linson 1999).

³⁶According to one researcher, "ask any teenager, or even any preteen, what she or he thinks that students gifted in mathematics and science look like, and it is likely that the answer will include an image that looks like the 'nerdy' scientist from *Back to the Future*: male, with glasses, a pocket protector, and a very strange hairdo....It is nearly impossible to encourage stu-

Public Confidence in Leadership of the Science Community

Public confidence in the leadership of various professional communities has been tracked for more than a quarter of a century (Davis and Smith annual series). Participants in the General Social Survey were asked whether they had a "great deal of confidence, only some confidence, or hardly any confidence at all" in the leadership of various professional communities. In 2000, 41 percent reported that they had a great deal of confidence in the leadership of the science community. Only the medical community received a greater vote of

confidence to do well in mathematics and science when they are faced with such ridiculous stereotypes everywhere they turn...We need more shows like *Apollo 13*, where scientists are shown as dedicated, intelligent professionals who lead exciting, fulfilling lives." (Sheffield 1997 pp. 377–78.)

confidence. Science has ranked second since 1978, when it displaced the education community for the first time. The military, Supreme Court, banks and financial institutions, major companies, organized religion, and education occupied the next six spots in 2000. The public had the least confidence in the press and television; in 2000, only 10 percent of respondents reported having a “great deal of confidence” in their leadership. (See figure 7-14 and appendix table 7-31.)

Although the vote of confidence for the science community has fluctuated somewhat since 1973, it has remained about 40 percent. In contrast, the vote of confidence for the medical profession, once as high as 60 percent in 1974, has been gradually declining during most of the past 25 years.

Public Perceptions of Scientists

The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses...He may wear a beard, may be...unkempt....He is surrounded by equipment...and spends his days doing experiments (Mead and Metraux 1957).

In the years since Margaret Mead first recorded her observations, several social scientists have administered the “Draw-a-Scientist” Test (DAST) to children. In this test, students are

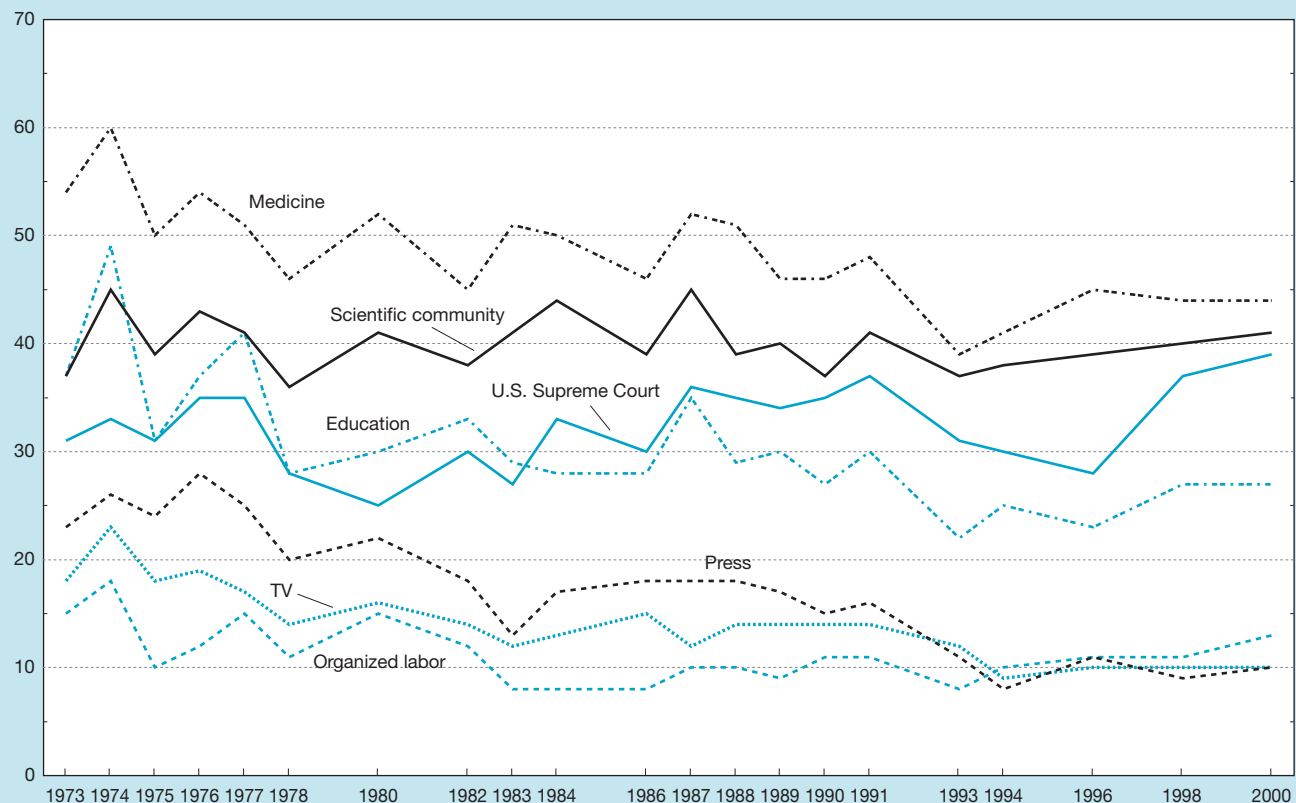
asked to draw pictures of scientists. Those pictures are then examined to see if they contain certain features normally associated with the stereotypical image of a scientist, including:

- ♦ a lab coat (usually white),
- ♦ eyeglasses,
- ♦ facial growth of hair (including beards, mustaches, or abnormally long sideburns),
- ♦ scientific instruments and laboratory equipment,
- ♦ books and filing cabinets,
- ♦ technology or the “products” of science, and
- ♦ captions, e.g., formulae, taxonomic classification, the “eureka!” syndrome.

Other features also are noted, such as the size of a scientific instrument in relation to the scientist; evidence of danger; the presence of light bulbs; the sex, race, or ethnicity of the scientist; and figures that resemble Einstein or “mad scientists” like Frankenstein (Chambers 1983). By counting the number of these indicators in the drawings, the researchers have been able to document the existence and prevalence of the stereotypical image of a scientist, one that contains at least several of the features cited above.

Figure 7-14.
Public confidence in leadership of selected institutions: 1973–2000

Percent expressing great deal of confidence



See appendix tables 7-31.

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According to the DAST research, the stereotypical image of a scientist is alive and well in the minds of children. Moreover, children seem to form this image early in life, by the time they reach the second grade. It is even more ingrained and pronounced among older children. That is, the older the children, the more identified features their drawings contain. One study found little difference between the images held by college students and those of younger students, despite the fact that the former had probably had contact with actual scientists during their years at college (Barman 1997; Fort and Varney 1989; Barman 1999; Rahm and Charbonneau 1997).

In 2001, the NSF survey included questions intended to measure public perceptions of scientists. Respondents were asked whether they agreed or disagreed with certain statements. For example, almost everyone (96 percent) agreed that “scientists are helping to solve challenging problems,” and 86 percent agreed that “scientific researchers are dedicated people who work for the good of humanity.” (See appendix tables 7-32 and 7-33.) Less than 20 percent thought that “a scientist usually works alone” and “scientists do not get as much fun out of life as other people do.” (See appendix tables 7-34 and 7-35.) Among these four statements, there was little, if any difference in perception between the sexes. However, the more formal education one had, the more positive the perception. This was true for two of the four items. For example, more than a third (37 percent) of those who had not graduated from high school thought that scientists did not get as much fun out of life as other people. This statistic dropped to 18 percent for high school graduates and to 11 percent for college graduates.

Four other statements included in the survey generated larger numbers of negative perceptions than the four items discussed above. However, fewer than half of those surveyed agreed that scientists:

- ♦ were apt to be odd and peculiar people (25 percent agreed),
 - ♦ had few other interests but their work (29 percent), and
 - ♦ were not likely to be very religious people (30 percent).
- (See appendix tables 7-36, 7-37, and 7-38.)

In contrast to the first group of questions, each of these statements produced a notable gender gap in perception, with more men than women having negative perceptions. For example:

- ♦ 28 percent of men agreed with the statement that scientists were odd and peculiar people compared with 22 percent of women,
- ♦ 33 percent of men but only 25 percent of women thought that scientists had few interests other than their work, and
- ♦ 34 percent of men versus 26 percent of women thought scientists were not likely to be very religious people.

Public Perceptions of Science Occupations

Despite the persistence of a stereotype that is difficult to dislodge, most people believe that scientists lead rewarding professional and personal lives. In fact, when asked how they would feel if their son or daughter wanted to become a scientist, 80 percent of respondents to the 2001 NSF survey said they would be happy with that decision (18 percent said they would not care and 2 percent reported they would be unhappy).³⁷ “Daughter” and “son” received equal percentages of positive responses, and men and women both “voted” the same way for both sons and daughters. (See appendix table 7-39.)

A Harris Poll Pilot Study conducted for the American Association of Engineering Societies in July 1998 produced what seems like an even higher level of enthusiasm for science as a career choice. This survey asked participants the following question:

Using a scale of 1 to 10, with 1 being extremely displeased and 10 being extremely pleased, if your son or daughter or other family member said they wanted to be a scientist, technician, or an engineer, how pleased would you be?

“Scientist” received the highest level of endorsement, a perfect 10 for a median response, followed by engineer at 9, and technician at 8 (American Association of Engineering Societies 1998). One of the many scientific professional societies, the American Chemical Society, recently commissioned a survey of the public’s attitudes toward its members and the work they do. Although the chemical industry did not receive high marks, its members did. (See sidebar “Public Perceptions of Chemistry, the Chemical Industry, and Chemists.”)

Despite these positive perceptions of science occupations, 53 percent of respondents to the 2001 NSF survey agreed that “scientific work is dangerous.” Equal percentages of men and women chose this response, but the level of agreement declined as the level of formal education rose. That is, 70 percent of those who had not completed high school agreed with the statement compared with 56 percent of high school graduates and 30 percent of college graduates. (See appendix table 7-40.)

Prestige of Science Occupations

Perceptions of science occupations can also be assessed by examining the prestige that the public associates with each. Respondents to the most recent Harris survey ranked “scientist” second among 17 occupations in terms of prestige; however, the engineering profession ranked eighth (Taylor 2000).³⁸ More than 50 percent of respondents chose “very great prestige” for three occupations: doctor (61 percent), scientist (56

³⁷In a study conducted in the United Kingdom, 74 percent of those surveyed said that science and engineering represent good career choices, while only 4 percent had the opposite point of view. The adjectives used most often to describe scientists and engineers were “intelligent, enquiring, logical, methodical, rational, and ...responsible” (Office of Science and Technology and The Wellcome Trust 2000).

³⁸The question asked in this survey was: “I am going to read off a number of different occupations. For each, would you tell me if you feel it is an occupation of very great prestige, considerable prestige, some prestige, or hardly any prestige at all?”

Public Perceptions of Chemistry, the Chemical Industry, and Chemists

The American Chemical Society (ACS) commissioned a survey of public attitudes towards chemistry and chemists. This survey, conducted in 2000 by The Wirthlin Group (The American Chemical Society 2000), had the following objectives:

- ♦ find out what the average person thinks about chemistry and chemists,
- ♦ assess public attitudes toward chemical companies and the chemical industry,
- ♦ measure public perceptions of chemists and chemistry as a career, and
- ♦ discover what factors influence perceptions of chemistry and the chemistry profession.

Perceptions of Chemistry

When asked to think about the word “science,” 20 percent of respondents mentioned “medicine” or “biology”; 14 percent mentioned astronomy; 11 percent, chemistry; 7 percent, space; and 6 percent, physics. Those with higher levels of education and income were more likely than others to mention chemistry.

Perceptions of the Chemical Industry

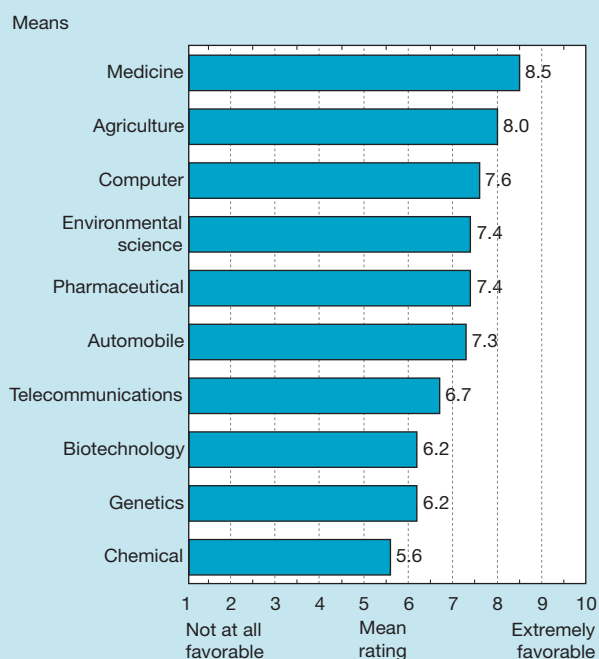
About one-third of those surveyed had an unfavorable opinion of chemical companies. Among the 10 industries included in the survey, the chemical industry ranked last. In contrast, medicine and agriculture had the most favorable ratings, followed by the computer, environmental science, pharmaceutical, automobile, telecommunications, biotechnology, and genetics industries. (See figure 7-15.)

Respondents expressing the least negative attitudes toward the chemical industry were those who had college degrees and/or household incomes exceeding \$60,000, Caucasians, those not concerned about the effects of chemicals on human health and safety, and those who thought chemicals had made their lives better.

The survey participants who gave chemical companies a favorable rating (43 percent) were more likely than others to mention the positive social effects of chemicals and to express the belief that chemicals improve the quality of life. This group also cited the positive role of chemistry in research and development, cleaning uses, and pesticides.

Those with unfavorable opinions toward chemical companies (34 percent) cited the environmental impact of chemicals, harm to health, and the bad publicity the industry receives. According to this set of respondents, chemical companies harm the environment by disposing of waste irresponsibly and polluting in other ways. The Exxon Valdez and other oil spills were also mentioned. Bad publicity includes the perception that companies do not communicate with consumers.

Figure 7-15.
Industry favorability for selected industries



NOTE: Responses are to the following statement: “Next I would like to read you a list of industries. For each one I mention, please tell me how favorable you are toward that industry using a 1 to 10 scale where 1 means you are not at all favorable and 10 means extremely favorable. You may use any number between 1 and 10.”

SOURCE: Figure reproduced from the American Chemical Society, National Benchmark Telephone survey, conducted by Wirthlin Worldwide, draft report, July 2000, Washington D.C.

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A strong majority—three out of five of those surveyed—felt that chemicals make their everyday lives better. The remaining respondents were split evenly between those who were neutral (20 percent) and those who thought chemicals had made their lives worse (20 percent).

The positive aspects of chemistry mentioned fall into two categories: (1) health-related, e.g., medicine and finding cures for diseases, and (2) specific products, e.g., cleaning or agricultural, that make their lives easier. Those who feel chemicals have made their lives worse cited environmental and health concerns.

Public Perceptions of Chemists and Chemistry as a Career

Although the chemical industry suffers from an image problem, the public seems to have a positive attitude toward chemistry as a profession. ACS survey respondents ranked a career as a chemist higher than that as an environmentalist, physicist, mathematician, psychologist/psychiatrist, and astronomer. Only physicians and pharmacists ranked higher. In addition, the public recognizes chem-

ists' contributions to health maintenance. With respect to this criterion, chemists once again ranked second only to physicians and pharmacists, and about even with environmentalists.

Although only 8 percent of respondents had offered advice to a friend or family member about becoming a chemist, of those who had, an overwhelming majority (87 percent) gave positive advice. The reasons given for offering encouragement included supporting the individual's choice, considering chemistry a good field with a good future, and believing that chemistry would not only provide the opportunity to help people and benefit society but also pay well.

Other findings included the following:

- ◆ A majority of survey respondents (72 percent) considered a career in basic chemical research more appealing than a career in the chemical industry (14 percent chose the latter). The reasons cited for the former included having the opportunity to make new discoveries that will benefit mankind and help others. Those who chose the latter career option cited better opportunities for career advancement and better pay.
- ◆ The leadership traits most closely associated with chemists included being a visionary, being innovative, and being results oriented.

Other Survey Findings

- ◆ Respondents said that their views were influenced almost entirely by newspaper, magazine, and television coverage of science topics. For most of the public, the primary sources of information for new de-

velopments and innovations involving chemists, chemistry, and chemicals are newspapers (34 percent), national television reports (28 percent), magazines/periodicals (27 percent), and local television reports (24 percent). The role of the Internet is still quite small: only 5 percent named it as a primary information source. (See "Where Americans Get Information About S&T.")

- ◆ Nearly 60 percent of respondents thought that they were poorly informed about new chemical developments and innovations. Only 12 percent of the respondents reported feeling very well informed about the role of chemicals in improving human health; 60 percent considered themselves somewhat informed. The remaining respondents indicated that they were not at all informed. Despite the low levels of knowledge of the role of chemicals in improving human health, 52 percent were very concerned and 35 percent were somewhat concerned about the effects of chemicals on human health and safety.
- ◆ When a chemical substance had become a danger to consumer health and safety, most people (54 percent) said that government regulators were to blame; 39 percent thought that the companies that sold the substance were responsible. Only 14 percent thought that the chemists who had discovered the substance were the most culpable.

percent), and teacher (53 percent). Although these percentages changed little between 1998 and 2000, the prestige of teachers has risen dramatically, from 28 percent in 1982 to 53 percent in 1998. During the same period, there was a relatively small gain in prestige for doctors and a relatively small loss for scientists.

This survey shows that engineers are accorded not only less prestige than doctors, scientists, and teachers, but also less prestige than ministers, military officers, policemen, and members of Congress.³⁹ According to a recent study, "engineers have enjoyed a consistent but mediocre prestige for the past 20 years" (American Association of Engineering Studies 1998). However, engineers command more respect than architects, lawyers, athletes, and entertainers. The bottom tier includes journalists, union leaders, businessmen, bankers, and accountants.

Are Public Perceptions Based on Knowledge?

Although people perceive science and other occupations in terms of prestige or other value measures, on what do they

base their perceptions? That is, how much do people actually know about science occupations and science professionals?

In response to the American Association of Engineering Societies survey in July 1998, sizable minorities of those surveyed did not consider themselves well informed about science and scientists (47 percent) or technology and technicians (41 percent). In addition, sizable percentages of survey respondents thought that the media did only a fair or poor job covering science (56 percent), technology (53 percent), and medical discoveries (44 percent).

The same survey produced telling statistics about the engineering profession. For example:

- ◆ 61 percent of respondents did not consider themselves well informed about engineering and engineers,⁴⁰ and
- ◆ 70 percent of respondents thought that the media did only a fair or poor job covering engineering.⁴¹

In addition, the public frequently underestimates the role engineers play in S&T advancement. For example, engineers

³⁹In a study conducted in the United Kingdom, engineering was perceived as a mostly male profession. Although the respondents tended to view the personalities of engineers as "cold and detached," they also saw them as more "socially responsible" and "sympathetic" than scientists (The Office of Science and Technology and The Wellcome Trust 2000).

⁴⁰The comparable figures for science and scientists and technology and technicians were 47 and 43 percent, respectively.

⁴¹The comparable figures for science, technology, and medical discoveries were 56, 53, and 44 percent, respectively.

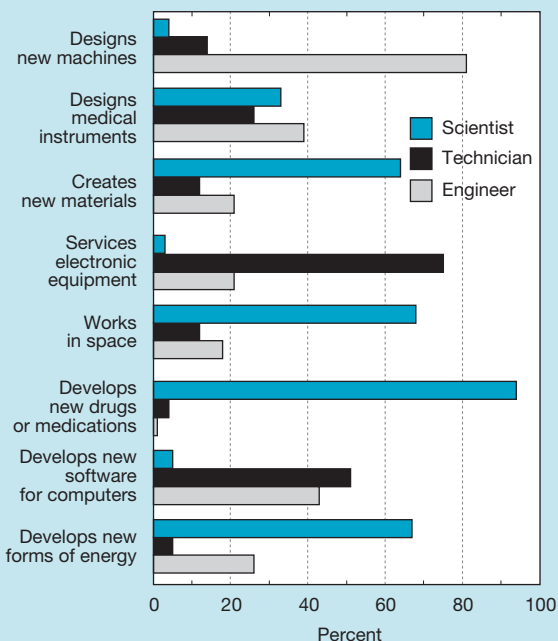
have a much larger role in conducting space research, developing new forms of energy, and creating new materials than the public gives them credit for. (See figure 7-16.) In addition, they are “perceived as pragmatic contributors to society—more so than are technicians—but are less attuned to societal issues than are scientists.” (See figure 7-17.)

Where Americans Get Information About S&T

Science on the Internet

Has the Internet displaced television and the print media as Americans’ primary source of news about current events or S&T? According to a 2000 Pew Research Center survey, the Internet is making inroads. Apparently, part of the time Americans used to spend watching the news broadcasts of ABC, CBS, NBC, and Fox is now being used to browse various news-oriented websites. (See sidebar “More Americans Are Turning to the Internet for News.”) In addition, people who have access to the Internet at home seem to know more about science and the scientific process and have more positive attitudes toward S&T. (See sidebar “Internet Access Is an Indicator of Both Attitudes Toward and Knowledge of S&T.”)

Figure 7-16.
Who does what—scientists, engineers, or technicians : 1998

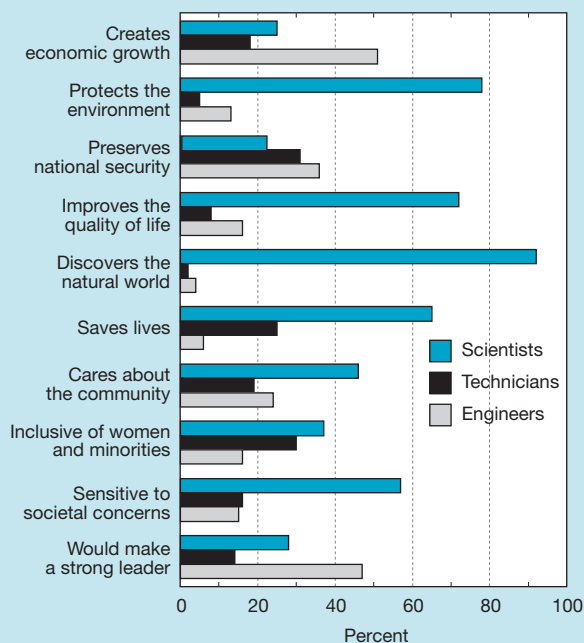


NOTE: Responses were to the question, “As I mention some activities, tell me who you *mostly* associate with that activity—a scientist, a technician, or an engineer?”

SOURCE: Louis Harris & Associates, Inc. “American Perspectives on Engineers & Engineering.” A “Harris Poll” Pilot Study conducted for the American Association of Engineering Societies. July 1998.

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Figure 7-17.
Public perception of scientists, engineers, and technicians: 1998



NOTE: Responses were to the question, “As I mention some characteristics, who first comes to mind—scientists, technicians, or engineers?”

SOURCE: Louis Harris & Associates, Inc. “American Perspectives on Engineers & Engineering.” A “Harris Poll” Pilot Study conducted for the American Association of Engineering Societies. July 1998.

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Despite its growing popularity, the Internet ranks a distant third as Americans’ chief source of news in general. Only 7 percent of respondents to the NSF survey identified it as their main source of information about what is happening in the world around them. In contrast, 53 percent of those surveyed identified television, and 29 percent said that they got most of their information about current news events from newspapers. The corresponding statistics for radio and magazines are 5 and 3 percent, respectively. (See figure 7-19 and appendix table 7-42.)

Although 9 percent of respondents to the 2001 NSF survey said that the Internet was their main source of information about S&T, this percentage is still substantially below the percentage of respondents who identified television (44 percent), newspapers (16 percent), and magazines (16 percent) as their primary source of S&T news. (See figure 7-19 and appendix table 7-43.)

The Internet, however, is the preferred source when seeking information about specific scientific issues. The following question was asked in the 2001 NSF survey: “If you wanted to learn more about a scientific issue such as global warming or biotechnology, how would you get more information?”

The response to this question makes it clear that encyclopedias and every other information resource have lost a substantial number of customers to the Internet. A plurality (44